

1           1.       In a computer system that has access to interlaced representation of video, a  
2 method of converting the interlaced representation of the video into a progressive  
3 representation of the video by converting a first temporal field and a subsequent second  
4 temporal field of interlaced video into a progressive frame so as to provide a high quality  
5 progressive frame with relatively little processing resources even if there is motion  
6 between the first temporal field and the second temporal field, the method comprising the  
7 following:

8                   an act of replicating one of the first temporal field or the second temporal  
9 field to generate half of the progressive frame;

10                  an act of estimating a correlation between a pixel of the other non-replicated  
11 temporal field and at least one vertically adjacent pixel of the replicated temporal  
12 field; and

13                  an act of assigning a value to a subject pixel in the other half of the  
14 progressive frame, the subject pixel corresponding to the position of the pixel of the  
15 non-replicated temporal field, wherein the value is based on the correlation.

16  
17       2.       A method in accordance with Claim 1, further comprising:

18                  an act of repeating the act of estimating a correlation and the act of  
19 assigning a value for each of the remaining pixels in the non-replicated temporal  
20 field;

21  
22       3.       A method in accordance with Claim 1, wherein the act of assigning a value  
23 to a subject pixel in the other half of the progressive frame comprises the following:

1 an act of assigning the value based on an interpolation between scan line  
2 interpolation and field merging depending on the correlation, wherein a higher  
3 correlation tends the value towards field merging and lower correlation tends the  
4 value towards scan line interpolation.

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6 4. A method in accordance with Claim 1, wherein the act of assigning the  
7 value based on an interpolation between scan line interpolation and field merging  
8 comprises the following:

9 an act of determining a correlation value between zero and one inclusive  
10 that represents the correlation between the pixel of the non-replicated temporal  
11 field and the at least one vertically adjacent pixel of the replicated temporal field,  
12 wherein the act of assigning a value based on an interpolation comprises the  
13 following:

14 an act of multiplying the correlation value by the value that would be  
15 obtained by pure field merging; and

16 an act of multiplying one minus the correlation value by the value that  
17 would be obtained by pure scan line interpolation.

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19 5. A method in accordance with Claim 4, wherein the act of multiplying one  
20 minus the correlation value by the value that would be obtained by pure scan line  
21 interpolation comprises the following:

22 an act of determining the value that would be obtained by pure scan line  
23 interpolation.

1           6.       A method in accordance with Claim 5, wherein the act of determining the  
2 value that would be obtained by pure scan line interpolation comprises the following:

3                   an act of averaging the value of the upper pixel in the replicated field that is  
4 immediately above the output position with the value of the lower pixel in the  
5 replicated field that is immediately below the output position.  
6

7           7.       A method in accordance with Claim 1, wherein the act of estimating a  
8 correlation comprises the following:

9                   an act of determining the correlation based on pixel values of field merged  
10 representations of the first and second temporal fields in a vertical column that  
11 includes the position of the subject pixel of the second temporal field.  
12

13           8.       A method in accordance with Claim 7, wherein the vertical column is five  
14 pixels in height, two pixels being above the subject pixel, and two pixels being below the  
15 subject pixel.  
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17           9.       A method in accordance with Claim 7, wherein the vertical column in three  
18 pixels in height, one pixel being above the subject pixel, and one pixel being below the  
19 subject pixel.  
20

1           10.     In a computer system that has access to interlaced representation of video, a  
2 method of converting the interlaced representation of the video into a progressive  
3 representation of the video by converting a first temporal field and a subsequent second  
4 temporal field of interlaced video into a progressive frame so as to provide a high quality  
5 progressive frame with relatively little processing resources even if there is motion  
6 between the first temporal field and the second temporal field, the method comprising the  
7 following:

8                     an act of replicating one of the first temporal field or the second temporal  
9 field to generate half of the progressive frame; and

10                    a step for generating the other half of the progressive frame so that the value  
11 of each pixel is adaptively determined on a per pixel basis depending on the vertical  
12 correlation in the first and second temporal fields at the position of the pixel.

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14           11.     A method in accordance with Claim 10, wherein the step for generating the  
15 other half of the progressive frame comprises the following:

16                    an act of estimating a correlation between a pixel of the other non-replicated  
17 temporal field and at least one vertically adjacent pixel of the replicated temporal  
18 field; and

19                    an act of assigning a value to a subject pixel in the other half of the  
20 progressive frame, the subject pixel corresponding to the position of the pixel of the  
21 non-replicated temporal field, wherein the value is based on the correlation.  
22

1           12.    A computer program product for use in a computer system that has access  
2 to interlaced representation of video, the computer program product for implementing a  
3 method of converting the interlaced representation of the video into a progressive  
4 representation of the video by converting a first temporal field and a subsequent second  
5 temporal field of interlaced video into a progressive frame so as to provide a high quality  
6 progressive frame with relatively little processing resources even if there is motion  
7 between the first temporal field and the second temporal field, the computer program  
8 product comprising a computer-readable medium having stored thereon computer-  
9 executable instructions which, when executed by one or more processors, cause the  
10 computer system to perform the following:

11                   an act of replicating one of the first temporal field or the second temporal  
12 field to generate half of the progressive frame;

13                   an act of estimating a correlation between a pixel of the other non-replicated  
14 temporal field and at least one vertically adjacent pixel of the replicated temporal  
15 field; and

16                   an act of assigning a value to a subject pixel in the other half of the  
17 progressive frame, the subject pixel corresponding to the position of the pixel of the  
18 non-replicated temporal field, wherein the value is based on the correlation.

19  
20           13.    A computer program product in accordance with Claim 12, wherein the  
21 computer-readable medium is a physical storage medium.

22  
23           14.    A computer program product in accordance with Claim 12, wherein the  
24 computer-readable medium further has stored thereon computer-executable instructions

1 which, when executed by one or more processors, cause the computer system to  
2 performing the following:

3 an act of repeating the act of estimating a correlation and the act of  
4 assigning a value for each of the remaining pixels in the non-replicated temporal  
5 field.

6  
7 15. A computer program product in accordance with Claim 12, wherein the  
8 computer-executable instructions which, when executed by one or more processors, cause  
9 the computer system to perform the act of assigning a value to a subject pixel in the other  
10 half of the progressive frame comprise computer-executable instructions which, when  
11 executed by one or more processors, cause the computer system to perform the following:

12 an act of assigning the value based on an interpolation between scan line  
13 interpolation and field merging depending on the correlation, wherein a higher  
14 correlation tends the value towards field merging and lower correlation tends the  
15 value towards scan line interpolation.

16  
17 16. A computer program product in accordance with Claim 12, wherein the  
18 computer-executable instructions which, when executed by one or more processors, cause  
19 the computer system to perform the act of assigning the value based on an interpolation  
20 between scan line interpolation and field merging comprises computer-executable  
21 instructions which, when executed by one or more processors, cause the computer system  
22 to perform the following:

23 an act of determining a correlation value that represents the correlation  
24 between the pixel of the non-replicated temporal field and the at least one vertically

1 adjacent pixel of the replicated temporal field, wherein the act of assigning a value  
2 based on an interpolation comprises the following:

3 an act of multiplying the correlation value by the value that would be  
4 obtained by pure field merging; and

5 an act of multiplying one minus the correlation value by the value that  
6 would be obtained by pure scan line interpolation.

7  
8 17. A computer program product in accordance with Claim 16, wherein the  
9 computer-executable instructions which, when executed by one or more processors, cause  
10 the computer system to perform the act of multiplying one minus the correlation value by  
11 the value that would be obtained by pure scan line interpolation comprise computer-  
12 executable instructions which, when executed by one or more processors, cause the  
13 computer system to perform the following:

14 an act of determining the value that would be obtained by pure scan line  
15 interpolation.

16  
17 18. A computer program product in accordance with Claim 17, wherein the  
18 computer-executable instructions which, when executed by one or more processors, cause  
19 the computer system to perform the act of determining the value that would be obtained by  
20 pure scan line interpolation comprise computer-executable instructions which, when  
21 executed by one or more processors, cause the computer system to perform the following:

22 an act of averaging the value of the upper pixel in the replicated field that is  
23 immediately above the output position with the value of the lower pixel in the  
24 replicated field that is immediately below the output position.

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19. A computer program product in accordance with Claim 12, wherein the computer-executable instructions which, when executed by one or more processors, cause the computer system to perform the act of estimating a correlation comprise computer-executable instructions which, when executed by one or more processors, cause the computer system to perform the following:

an act of determining the correlation based on pixel values of field merged representations of the first and second temporal fields in a vertical column that includes the position of the subject pixel of the second temporal field.



1           20.     In a computer system that has access to interlaced fields of video, a method  
2 of converting three temporally adjacent input fields of interlaced video into two output  
3 fields of interlaced video, the method comprising the following:

4                     an act of replicating the second temporal input field to reproduce a first of  
5 the output fields;

6                     for a given output pixel corresponding to an output position of the second  
7 output field, an act of using at least one pixel of the second temporal input field that  
8 is vertically adjacent to the output position of the second output field to determine  
9 which of the first temporal input field and third temporal input field more closely  
10 correlates to the second temporal input field at the output position; and

11                    an act of assigning a value to the output pixel based on the correlation  
12 between the first temporal input field and the second temporal input field, and  
13 between the third temporal input field and the second temporal input field  
14 corresponding to the output position.

15  
16           21.     A method in accordance with Claim 20, wherein the act of using at least one  
17 pixel of the second temporal input field that is vertically adjacent to the output position of  
18 the second output field to determine which of the first temporal input field and third  
19 temporal input field more closely correlates to the second temporal input field at the output  
20 position comprises the following:

21                    an act of accessing an upper pixel of the second temporal input field which  
22 is directly above the output position of the second output field;

23                    an act of accessing a lower pixel of the second temporal input field that is  
24 directly below the output position of the second output field;

1 an act of interpolating a value based on the values of the upper pixel and the  
2 lower pixel; and

3 an act of using the interpolated value to determine which of the first  
4 temporal input field and the third temporal input field more closely correlates to the  
5 second temporal input field at the output position.

6  
7 22. A method in accordance with Claim 21, wherein the act of interpolating a  
8 value based on the values of the upper pixel and the lower pixel comprises the following:

9 an act of averaging the value of the upper pixel with the value of the lower  
10 pixel to generated the interpolated value.

11  
12 23. A method in accordance with Claim 21, wherein the act of using the  
13 interpolated value to determine which of the first temporal input field and the third  
14 temporal input field more closely correlates to the second temporal input field comprises  
15 the following:

16 an act of comparing the interpolated value to the value of the pixel in the  
17 first temporal input field that correlates to the output position; and

18 an act of comparing the interpolated value to the value of the pixel in the  
19 third temporal input field that correlates to the output position.

20  
21 24. A method in accordance with Claim 21, wherein the act of assigning a value  
22 to the output pixel based on the correlation between the first temporal input field and the  
23 second temporal input field, and between the third temporal input field and the second  
24 temporal input field corresponding to the output position comprises the following:

1 an act of tending the value of the output pixel more towards the value of the  
2 pixel in whichever of the first temporal input field or third temporal input field at  
3 the output position is closer to the interpolated value.  
4

5 25. A method in accordance with Claim 24, wherein the act of tending the value  
6 of the output pixel comprises the following:

7 an act of keeping track of a blending factor that is used to determine how  
8 much of the value of the pixel in the first temporal input field at the output position,  
9 and how much of the value of the pixel in the third temporal input field at the  
10 output position is weighed in assigning the value to the output pixel.  
11

12 26. A method in accordance with Claim 25, further comprising the following:

13 an act of changing the value of the blending factor in one direction if the  
14 interpolated value is closer to the value of the pixel in the first temporal input field  
15 at the output position;

16 an act of changing the value of the blending factor in the opposite direction  
17 if the interpolated value is closer to the value of the pixel in the third temporal input  
18 field at the output position; and

19 an act of using the changed blending factor when analyzing the next  
20 horizontally adjacent output pixel.  
21

27. A computer program product for use in a computer system that has access to interlaced fields of video, the computer program product for implementing a method of converting three temporally adjacent input fields of interlaced video into two output fields of interlaced video, the computer program product comprising a computer-readable medium having stored thereon computer-executable instructions which, when executed by one or more processors, cause the computer system to perform the following:

an act of replicating the second temporal input field to reproduce a first of the output fields;

for a given output pixel corresponding to an output position of the second output field, an act of using at least one pixel of the second temporal input field that is vertically adjacent to the output position of the second output field to determine which of the first temporal input field and third temporal input field more closely correlates to the second temporal input field at the output position; and

an act of assigning a value to the output pixel based on the correlation between the first temporal input field and the second temporal input field, and between the third temporal input field and the second temporal input field corresponding to the output position.

28. A computer program product in accordance with Claim 27, wherein the computer-executable instructions which, when executed by one or more processors, cause the computer system to perform the act of using at least one pixel of the second temporal input field that is vertically adjacent to the output position of the second output field to determine which of the first temporal input field and third temporal input field more closely correlates to the second temporal input field at the output position comprise

1 computer-executable instructions which, when executed by one or more processors, cause  
2 the computer system to perform the following:

3 an act of accessing an upper pixel of the second temporal input field which  
4 is directly above the output position of the second output field;

5 an act of accessing a lower pixel of the second temporal input field which is  
6 directly below the output position of the second output field;

7 an act of interpolating a value based on the values of the upper pixel and the  
8 lower pixel; and

9 an act of using the interpolated value to determine which of the first  
10 temporal input field and the third temporal input field more closely correlates to the  
11 second temporal input field at the output position.

12  
13 29. A computer program product in accordance with Claim 28, wherein the  
14 computer-executable instructions which, when executed by one or more processors, cause  
15 the computer system to perform the act of interpolating a value based on the values of the  
16 upper pixel and the lower pixel comprise computer-executable instructions which, when  
17 executed by one or more processors, cause the computer system to perform the following:

18 an act of averaging the value of the upper pixel with the value of the lower  
19 pixel to generated the interpolated value.

20  
21 30. A computer program product in accordance with Claim 28, wherein the  
22 computer-executable instructions which, when executed by one or more processors, cause  
23 the computer system to perform the act of using the interpolated value to determine which  
24 of the first temporal input field and the third temporal input field more closely correlates to

1 the second temporal input field comprise computer-executable instructions which, when  
2 executed by one or more processors, cause the computer system to perform the following:

3 an act of comparing the interpolated value to the value of the pixel in the  
4 first temporal input field that correlates to the output position; and

5 an act of comparing the interpolated value to the value of the pixel in the  
6 third temporal input field that correlates to the output position.

7  
8 31. A computer program product in accordance with Claim 28, wherein the  
9 computer-executable instructions which, when executed by one or more processors, cause  
10 the computer system to perform the act of assigning a value to the output pixel based on  
11 the correlation between the first temporal input field and the second temporal input field,  
12 and between the third temporal input field and the second temporal input field  
13 corresponding to the output position comprise computer-executable instructions which,  
14 when executed by one or more processors, cause the computer system to perform the  
15 following:

16 an act of tending the value of the output pixel more towards the value of the  
17 pixel in whichever of the first temporal input field or third temporal input field at  
18 the output position is closer to the interpolated value.

19  
20 32. A computer program product in accordance with Claim 31, wherein the  
21 computer-executable instructions which, when executed by one or more processors, cause  
22 the computer system to perform the act of tending the value of the output pixel comprise  
23 computer-executable instructions which, when executed by one or more processors, cause  
24 the computer system to perform the following:

1 an act of keeping track of a blending factor that is used to determine how  
2 much of the value of the pixel in the first temporal input field at the output position,  
3 and how much of the value of the pixel in the third temporal input field at the  
4 output position is weighed in assigning the value to the output pixel.

5  
6 33. A computer program product in accordance with Claim 32, wherein the  
7 computer-readable medium further has stored thereon computer-executable instructions  
8 which, when executed by one or more processors, cause the computer system to perform  
9 the following:

10 an act of changing the value of the blending factor in one direction if the  
11 interpolated value is closer to the value of the pixel in the first temporal input field  
12 at the output position;

13 an act of changing the value of the blending factor in the opposite direction  
14 if the interpolated value is closer to the value of the pixel in the third temporal input  
15 field at the output position; and

16 an act of using the changed blending factor when analyzing the next  
17 horizontally adjacent output pixel.

18  
19 34. The computer program product in accordance with Claim 27, wherein the  
20 computer-readable medium is a physical storage medium.

1           35.     In a computer system that has access to interlaced fields of video, a method  
2 of converting three temporally adjacent input fields of interlaced video into two output  
3 fields of interlaced video for improved processing of sudden difference video, the method  
4 comprising the following:

5                     an act of replicating the second temporal input field to reproduce a first of  
6 the output fields; and

7                     a step for generating the second output field pixel-by-pixel considering  
8 similarities between temporal input fields.